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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/725,903	12/01/2003	Bernhard Wieneke	F-8054	3194

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EXAMINER	
CHEN, CHIA WEI A	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/725,903	WIENEKE, BERNHARD	
	Examiner	Art Unit	
	CHIA-WEI A. CHEN	2622	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *13 August 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *13 August 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed 8/13/2007 have been fully considered but they are not persuasive.

Applicant argues with respect to claims 1-10, that McDowell does not teach determining the point correspondences between two cameras by measuring the displacement of the interrogation fields in the camera images by means of optical cross-correlation.

However, McDowell teaches in col. 6, lines 39-65 that point correspondences between the two cameras are calculated from the two-dimensional camera views (interrogation fields). Each individual camera has its own coordinate system ($+X_1$, $+Y_1$, $+Z_1$) for the first camera and ($+Z_2$, $+X_2$, $+Y_2$) for the second camera. The relationship (point correspondences) between the two camera coordinate systems must be determined to correlate the two-dimensional camera determined measuremens to real, three-dimensional positions in an absolute coordinate system ($+X_W$, $+Y_W$, $+Z_W$). McDowell discloses the method in which this optical correlation is determined in col. 6, line 66 to col. 7, line 65.

Applicant further argues that the reference does not describe a calibration as a precursor to a PIV method, stereo PIV method, or 3D PIV method.

However, the McDowell reference clearly describes "the camera calibration approach of the present invention can be divided into the following nine steps" in col. 7, line 66 to col. 8, line 21.

Thus the rejections of independent claim1 and all dependent claims are sustained.

Claim Objections

2. Claims 1 and 6 are objected to because of the following informalities:

Claim 1: in the first two lines of page 3 of the Claims submitted 8/13/2007, the limitation "the point correspondences and the displacement of respective interrogations is" is repeated from the last line of page 2 of the Claims.

Claim 6: in the first line of claim 6 on page 4 of the Claims, it appears that the limitation should read "The method according to claim 1..." The examiner will examine claim 6 as dependent on claim 1.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

3. Claims 1-6, 9, and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over McDowell (US 5,905,568).

As to claim 1, McDowell et al. discloses a method for determining the imaging equation for self calibration (col. 7, line 47-col. 8 line 30) with regard to performing stereo-PIV methods on visualized flows (see col. 2, lines 42-48), said method being comprised of:

- providing at least two cameras (col. 2, line 65 – col. 3, line 2) and one image sector (Fig. 1A), with the cameras viewing approximately a same area of an illuminated section but from different directions (Fig. 1A);
- taking first and second images using respectively first and second camera of the two cameras, the first and second images respectively having corresponding interrogation areas (col. 7, lines 14-46);
- determining point correspondences between the two cameras by measuring a displacement of respective interrogation areas in the first and second images using optical cross-correlation (col. 3, lines 27-39); and
- determining the imaging equation by means of an approximation method, using known internal and external camera parameters and the point correspondences and the displacement of respective interrogation areas (col. 7, lines 49-52);

But is silent regarding wherein the two images are taken simultaneously. McDowell teaches wherein the left camera view and the right camera view are calibrated separately. This teaching does not preclude the calibrations from happening simultaneously. In fact, McDowell teaches that the cameras can record the two views simultaneously during operation (col. 5, lines 9-10; col. 13, line 65-col. 14, line 10). Therefore, it would have been obvious to one of ordinary skill in the art to have performed the calibration simultaneously for quick operation.

As to claim 2, McDowell et al. teaches the method according to claim 1, wherein the internal camera parameters include focal length (col. 7, lines 18-19 and 35-36), position

of optical axes (x_0, y_0) (col. 6, lines 29-36) and distortion parameters of camera optics (e.g. "camera aberrations"; see col. 4, line 2).

As to claim 3, McDowell et al. teaches the method according to claim 1, wherein the external parameters include position and orientation of the cameras relative to each other (col. 3, lines 18-20).

As to claim 4, McDowell et al. teaches the method according to claim 1, wherein if position of the illuminated section relative to a coordinate system of a known imaging equation is unknown, the position of the illuminated section is determined using the point correspondences (col. 3, lines 35-39).

As to claim 5, McDowell et al. teaches the method according to claim 1, wherein if one or several of the internal camera parameters are known, other ones of the internal and external camera parameters are determined using the point correspondences in order to thus determine the imaging equation (col. 7, lines 55-65).

As to claim 6, McDowell et al. teaches the method according to claim 1, further comprising:

- taking two or more camera images respectively by the at least two cameras at sequential times t_0 to t_n (col. 12, lines 33-36),

- determining a two-dimensional correlation function c_0 (dx, dy) to c_n (dx, dy) by means of optical cross-correlation at each time t_0 to t_n using corresponding ones of the images (centroid determination col. 9, lines 30-46),
- adding up the correlation functions c_0 to c_n (Eq. 1);
- determining correlation peaks and a highest correlation peak, and
- determining the displacement dx, dy of the respective one of the interrogation areas and, as a result thereof, the point correspondences being determined after based on the determination of the highest correlation peak (A global-optimization scheme, e.g. GESA algorithm in col. 13, lines 30-41, determines the best match of the tracer particle tracks, i.e. correlation peaks, and point correspondences are determined; col. 12, line 66-col. 13, line 12).

As to claim 9, McDowell et al. teaches the method according to clam 1, wherein each of the two cameras takes in short succession two images and that additional point correspondences are determined using a cross-correlation between the images at the times t and t+dt (col. 5, lines 41-54).

As to claim 10, McDowell et al. teaches the method according to claim 1, wherein optical axes of the at least two cameras are disposed coplanar to each other. (i.e., When the principal optical axes "Z_1 and Z_2" of the two cameras are equal.) (See col. 6, lines 39-50.)

4. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over McDowell et al. (US 5,905,568) in view of Meng, Xiaoqiao and Hu, Zhanyi "A new easy camera calibration technique based on circular points."

As to claim 7, McDowell et al. teaches the method according to claim 1, but does not teach wherein the approximation method is based on the Levenberg-Marquardt algorithm.

Meng, Xiaoqiao and Hu, Zhanyi "A new easy camera calibration technique based on circular points." (Meng and Hu) teaches wherein the approximation method is based on the Levenberg-Marquardt algorithm (section 2.2 of Meng and Hu).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the Levenberg-Marquardt algorithm of Meng and Hu with the method of McDowell et al. to "optimize a cost function by solving with a standard optimization algorithm." (see section 2.2 of Meng and Hu).

As to claim 8, Elder et al. teaches wherein the RANSAC algorithm is superimposed on the Levenberg-Marquardt algorithm (section 2.3 of Meng and Hu).

5. Claims 11 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over McDowell et al. (US 5,905,568) in view of Raffel et al. (US 5,610,703).

As to claim 11, McDowell et al. teaches the method according to claim 6, but does not teach wherein a section thickness of illuminated sections corresponding to respective timing of the images is determined through a width of the correlation peaks and a geometrical factor and that, together with the position of the illuminated sections in space, said thickness serves to determine an overlap between the illuminated sections and whether they are suited for PIV measurement.

Raffel et al. teaches wherein a section thickness (e.g., light sheet thickness; col. 6, line 54) of illuminated sections corresponding to respective timing of the images is determined through a width of the correlation peaks and a geometrical factor and that, together with the position of the illuminated sections in space, said thickness serves to determine an overlap between the illuminated sections and whether they are suited for PIV measurement. (see col. 6, lines 47-56).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the overlap determination of Raffel et al. with PIV imaging method of McDowell et al. so that "the ambiguity of the sign of the out-of-plane velocity component can be removed." (See col. 6, lines 59-61 of Raffel)

As to claim 14, this claim differs from claim 11 only in that the limitation "image geometry" is recited in place of "a geometrical factor." Thus claim 14 is analyzed as previously discussed. Raffel et al. clearly teaches "image geometry" (e.g., interrogation windows; see col. 6, lines 31-40).

6. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over McDowell et al. (US 5,905,568) in view of Walker, Stephen "Two-Axis Scheimpflug Focusing for Particle Image Velocimetry".

As to claim 13, McDowell teaches the method according to claim 5, but does not teach wherein if a Scheimpflug adapter is used and with assumption that said Scheimpflug adapter is optimally adjusted, an angle between a camera chip and a main axis and a position of a principal point on the camera chip are computed from the external image parameters and need not be fitted as a result thereof.

Walker, Stephen "Two-Axis Scheimpflug Focusing for Particle Image Velocimetry" (Walker) teaches wherein if a Scheimpflug adapter is used and with assumption that said Scheimpflug adapter is optimally adjusted, an angle between a camera chip and a main axis and a position of a principal point on the camera chip are computed from the external image parameters and need not be fitted as a result thereof (see Section 2.1, Fig. 1a, and Fig. 1b of Walker).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to have used the Scheimpflug adapter of Walker with the method of McDowell et al. to "permit focusing on a plane from a non-orthogonal position relative to the plane of measurement." (See Section 1 of Walker.)

As to claim 12, Walker teaches wherein with assumption of focusing on the particles in the illuminated section during the approximation method, an image width is calculated as a function of focal length of objectives of the two cameras and of a spacing between the illuminated section and the two cameras and needs not be fitted as a result thereof (see equation (1) of Walker).

Conclusion

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CHIA-WEI A. CHEN whose telephone number is (571)270-1707. The examiner can normally be reached on Monday - Friday, 7:30 - 17:00 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NgocYen Vu can be reached on (571) 272-7320. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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08/04/2008

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